

A SURVEY AND ECOLOGICAL STUDY OF THE SQUARE-SPOTTED CLAY *XESTIA RHOMBOIDEA* (ESPER.) IN CAMBRIDGESHIRE AND ESSEX WITH ADDITIONAL RESULTS FROM SCOTLAND AND WALES

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Abstract

The behaviour of the Square-spotted clay *Xestia rhomboidea*, a UK Biodiversity Action Plan moth species, was investigated in Cambridgeshire and Essex during a three year period. Larvae were found on 30 different occasions at 16 sites; larvae were also discovered at two sites in Scotland. The main larval foodplants were Common nettle *Urtica dioica*, Dog's mercury *Mercurialis perennis*, Oxlip *Primula elatior* and Primrose *Primula vulgaris*. The larvae were observed in the wild between the 10 January and the 12 April and could be found from dusk onwards feeding at the top of the larval foodplants. Adults were observed nectaring around dusk and later caught in light traps around dawn, mainly in August. The woodlands between Cambridge and St Neots seem to be a stronghold of this species which was found on ride and woodland edges of not only ancient woodlands, but also in secondary woodland, recent plantations and shelterbelts.

Introduction

The aim of this study was to investigate the autecology of the Square-spotted Clay *Xestia rhomboidea*, a UK Biodiversity Action Plan species. The study was based mainly in Cambridgeshire and Essex, but three separate visits to Scotland and one to Wales are included in the study period March 2002 and August 2005. Little was known about either the distribution or ecology of the species in Cambridgeshire and Essex before the project started. The Species Action Plan (SAP) (UK Biodiversity Group, 1999) suggested the larvae used Chickweed *Stellaria media*, Dock *Rumex* spp., Sallows *Salix caprea*, Primrose *Primula vulgaris*, Birch *Betula* spp., Bramble *Rubus fruticosus* agg. and Ribwort plantain *Plantago lanceolata* and the adults had been recorded nectaring on the flowers of Burdock *Artium* spp., Rosebay willowherb *Epilobium angustifolium*, Woodsage *Teucrium scorodonia* and Ragwort *Senecio* spp. in August.

A short extract from Ebert (1998) on behaviour in Europe suggested several larval food plants such as *P. vulgaris*, Oxlip *Primula elatior*, Common nettle *Urtica dioica*, and Blackthorn *Prunus spinosa*. The habitats the species occupies in continental Europe were given as bushy embankments, track margins, railway embankments, hedgerows, gardens and parklands. Ebert (1998) also listed species which the moth was seen to nectar on in mainland Europe and these included: Majoram *Origanum vulgare*, Ragwort *Senecio fuchsia*, Buddleia *Buddleja davidii*, Soft rush *Juncus effusus* and thistles (no Latin given), plus artificial bait such as sugaring mixture.

Waring (2002) reported that 17 *X. rhomboidea* had been caught in a light trap set on National Moth Night in 2001 at Overhall Grove, Cambridgeshire. Several adults had also been light trapped in the Fulbourn area of Cambridge, at RSPB Fowlmere and in the north of Essex over the last few years (Field, 2003). These records were the starting point for this research.

Methods

The historical records of adult observations in Cambridgeshire were reviewed and likely sites identified. These sites were then visited during the periods October to April for larvae and July and August for adults. The larval searches commenced around dark and in 2002 the areas searched were adjacent to where adults had been previously light-trapped. At that stage all the ground vegetation was searched as our only guide was the larval food plants suggested by Skinner (1998) and identified in the UK BAP (UK Biodiversity Group, 1999). All the low growing vegetation was therefore checked using torch light. Larvae identified were recorded, and surrounding vegetation noted. In 2003, 2004 and 2005, further similar searches were carried out but mainly confined to woodland and ride edges and areas of sparse scrub.

The behavioural study of captive larvae commenced in early 2003 and continued in 2004 when 200 mm diameter flower pots were planted with *U. dioica* and *P. vulgare*. Each pot had one large *U. dioica* plant and four *P. vulgare* plants planted in it. The pots were then placed in nets and put outside in a sheltered spot. One *X. rhomboidea* larva was placed in each of the pots. The behaviour of each larva was observed between February and April (2004), and March and June (2003). Observations began on some nights two hours before dusk and on others continued until dawn. Temperature and weather conditions were also recorded on each occasion.

Light trapping for adults started in 2002 and continued in 2003. Some of these sessions involved all night trapping with multiple traps, while others continued only until about midnight with single traps. In 2004 and 2005 no specific light trapping took place but records were collected from moth trapping events in Cambridgeshire, Essex and Scotland.

Searches for adults nectaring also took place about one hour before and one hour after dusk. This involved searching vegetation in flower on the edge of woodlands or in woodland rides. Adults were recorded along with time and weather conditions. While searching for adults nectaring, time was also taken to try to find females egg-laying. This involved trying to find females flying and following them to egg-laying sites. This was only carried out for the hours either side of dusk due to the difficulty of finding the moths in flight in full darkness.

Searches for eggs were carried out in August when several surveyors searched all branches, leaves and undergrowth within reach at sites known to hold strong populations. These took place in daylight and covered several sites in Cambridgeshire in 2003 and 2004 and Scotland in 2004.

Results

Larval searches

Larvae were searched for at 28 sites in England, 10 sites in Scotland and four sites in Wales (Field, 2005a). Larvae were recorded from 16 sites in England, of which two are in Essex (Waring & Field, 2004) and the remainder are in Cambridgeshire (Field, 2005b), and two sites in Scotland (Field & Gardiner, 2004) (Table 1). Larvae were observed in the wild from 10 January to 12 April and they were found feeding on

nine different species. These were *U. dioica* (62% of larvae observed), Dog's mercury *Mercurialis perennis* (25%), *P. elatior* (4.4%), Cow parsley *Anthriscus sylvestris* (4.4%), *P. vulgare*, Lords and ladies *Arum maculatum*, Cleavers *Galium aparine*, Creeping buttercup *Ranunculus repens* and *R. fruticosus*. In 21 timed sessions over 128 hours a larva was found every 2.06 (0.22-9.75) person hours.

The majority of the larvae were observed on the drip line at the edge of either woodland rides or on the woodland edge. Some larvae were found within very open scrubby woodland and in Scotland the larvae were several metres from the drip line outside the woodland edge (Field & Gardiner, 2004). There is often Elm *Ulmus* spp. present near to where the larvae were found but in Scotland and at least one other site there was no *Ulmus* spp. present. The larvae started to climb the food plants about two hours before dark and remain part on the plant and part on the soil in a reared up position until dark. At dusk the larvae rapidly moved to the top of the larval food plants and can be readily found by searching with torchlight. At no time during the period January to April were the larvae found feeding on the leaves of woody vegetation as suggested in the SAP. In fact at Hilly Wood the larvae were found on the field side of a wet ditch surrounding the wood, with no woody vegetation on that side of the ditch (Waring & Field, 2002).

The larvae seem to be active even when the temperature was as low as 2°C, but were never found in conditions when the temperature was 0°C or less, which it was during four hours of the observations.

Captive stock

While in captivity larvae were seen to feed on *P. vulgaris* and *Prunus domestica insititi*, but showed no interest in *Rubus* spp. leaves. They commenced feeding as soon as it became dark and continued for a couple of hours. By day they hid under plant debris or in the top layer of soil. All four larvae had completed growth by the end of March. The larval skins were shed and pupae formed during the first week of May (Waring and Field, 2002).

The behaviour of the captive larvae was observed for 70 hours in the period 18 March to 27 April 2003. In this period the larvae were observed to appear about two hours before dark and lie with the front part of the body on the base of a larval food plant stem and the rest of the body on the soil. They remained in this reared up position until dusk and then climbed quickly to the top of the plant and started to feed (Field, 2005a). Feeding was observed on nearly 66% of observations, with feeding on *P. vulgare* leaves being the more popular, followed by feeding on *U. dioica* and then feeding on *P. vulgare* flowers. As the *U. dioica* became older with less new growth, they were avoided and more feeding took place on *P. vulgare*. Feeding continued for most of the night but by 5.00 am (prior to dawn and still dark) the larvae had disappeared.

In captivity, the larvae were seen feeding between 2°C and 17°C. In the wild, the lowest temperature larvae were recorded feeding was 2°C. The only night the weather seemed to have an affect on feeding was on the 1 April 2003, when it was windy and cold. One larva was reared up on a *P. vulgare* stem before dark, but did not climb up to feed.

Neither of the two captive larvae were seen during the period 24 to 29 March 2003, but on 30 March one larva reappeared in a final instar and returned to feeding. The other was not seen feeding until 4 April. Both larvae then continued to feed every night until 18 April, but by 26 April neither was feeding. On 27 April, one larva had turned almost completely white, with just the darker wedge shaped markings left. The larva was hiding under the vegetation and was placed in a box of soil with *P. vulgare* leaves on the top. The larva fed for the last time on 28 April and then descended into the soil, pupating on 17 June. A further study was carried out in 2004 using four larvae and four netted pots. Very similar behaviour was observed with feeding taking place most nights

The female lays its eggs singly and glues them to leaves and stems. In captivity the eggs were laid over both the upper side and undersides of *U. dioica* leaves. In 2003 one female laid eggs on the underside of *U. dioica* leaves in preference to *U. minor* leaves. The eggs are white when laid but became dark in colour and hatch after about 9-10 days. In an experiment conducted with young larvae, three groups were fed, one with *Ulmus* spp. leaves, one with *U. dioica* leaves and a third with a mixture of the two. The larvae reached 5-6mm in 10 days and after a month were 10-11mm in length. The growth was similar from all three groups, but the group given a choice preferred *U. dioica* leaves but not exclusively. These larvae were still feeding at the end of September and had reached a similar size as larvae found in January and February. It is therefore suspected that they must become inactive during the autumn and early winter and resume feeding once the temperature rises again (Field, 2005a).

Larvae collected from the wild were also found to accept the leaves of other woody perennials in addition to elms in captivity, including Bullace *Prunus domestica* (Waring, 2002), but were never seen feeding on the foliage or any other part of any woody perennial during the many hours of spring searches.

Adults

Adults were observed at 24 sites across Cambridgeshire and Essex (Figure 1). Fourteen of these sites were where larvae had been found and adults were also found at Hail Lane Abbotsley, Abbotsley, Eversden Wood, Barton, Wicken Fen, Eltisley, The Gorse (TL 247614), Duloe Brook, Dry Drayton and Chippenham Fen. Other sites with recent records for adults such as The Belts, Wimpole Hall (2000); Drumguish (2000), Glen Nant (2005 J. Halliday pers. com.) (Field & Gardiner, 2004); Lake Vyrnwy (1987), Coedydd Aber (1996)(Field, 2005b) and Taynish (2004 & 2005) (Field, 2005c) were also searched for larvae without any being located.

Adults fly from late July and a few are still on the wing late in August in Cambridgeshire and Essex. In Scotland the limited data suggests that they may be on the wing about two weeks earlier than in England. Both male and female nectar and come to light, but far more males were light trapped than females. Of the 20 adults seen nectaring, ten (50%) were on Teasle *Dipsacus fullonum*, eight (40%) were on *A. minus*, one (5%) on Ragwort *Senecio jacobaea* and one (5%) on Black knapweed *Centaurea nigra*. Nectaring mainly occurs half an hour before dusk to an hour after dusk. Likewise adults seem to come to light within an hour of dusk and then again

much later in the night (mainly near to dawn). Egg-laying has never been seen in the wild and eggs have only been found once (on *Ulmus* spp. leaves). Five eggs which were an exact match to eggs obtained at the time from wild females were found on 18 August 2002 laid singly on the outer edge of the underside of leaves of sapling *Ulmus* spp. within a shelter-belt of trees and undergrowth. The eggs were at approximately head height (Edwards & Joy, 2003). One of these eggs was collected and supplied to PW for confirmation of identification. It was certainly a close match, but the egg never hatched for confirmation as larva and adult. Several subsequent searches of this site and elsewhere, failed to produce results.

Table 1. Larval records 2002-2005

Site	Number	Date
Overhall Grove	2 larvae	22/03/02
Hilly Wood	3 larvae	25/03/02
Overhall Grove	2 larvae	29/03/02
Overhall Grove	2 larvae	04/04/02
Overhall Grove	4 larvae	11/04/02
Whitehills Plantation	9 larvae	12/3/03
Fulbourn Fen NR	6 larvae	17/3/03
RSPB Fowlmere	5 larvae	24/3/03
RSPB Grange Farm	5 larvae	27/3/03
Overhall Grove	6 larvae	27/3/03
Oxey Wood	2 larvae	28/3/03
New Farm	30 larvae	31/3/03
Gamlingay Wood	7 larvae	2/4/03
Hilly Wood	1 larva	4/4/03
RSPB Fowlmere	6 larvae	12/4/03
Lodge Farm Fulbourn	1 larva	3/2/04
Fulbourn Fen NR	10 larvae	11/2/04
Little Paxton Pits	1 larva	2/3/04
Freewood	1 larva	15/3/04
Melwood	6 larvae	16/3/04
New Farm	3 larvae	17/3/04
Langley Upper Green	2 larvae	17/3/04
Carr Brae	2 larvae	22/3/04
Arduaine	1 larva	26/3/04
Oxey Wood	1 larva	26/3/04
Bedford Purlieus	1 larva	7/4/04
Fulbourn Fen NR	2 larvae	10/1/05
Fulbourn Fen NR	2 larvae	17/1/05
Elton	2 larvae	31/3/05
Elton	2 larvae	6/4/05

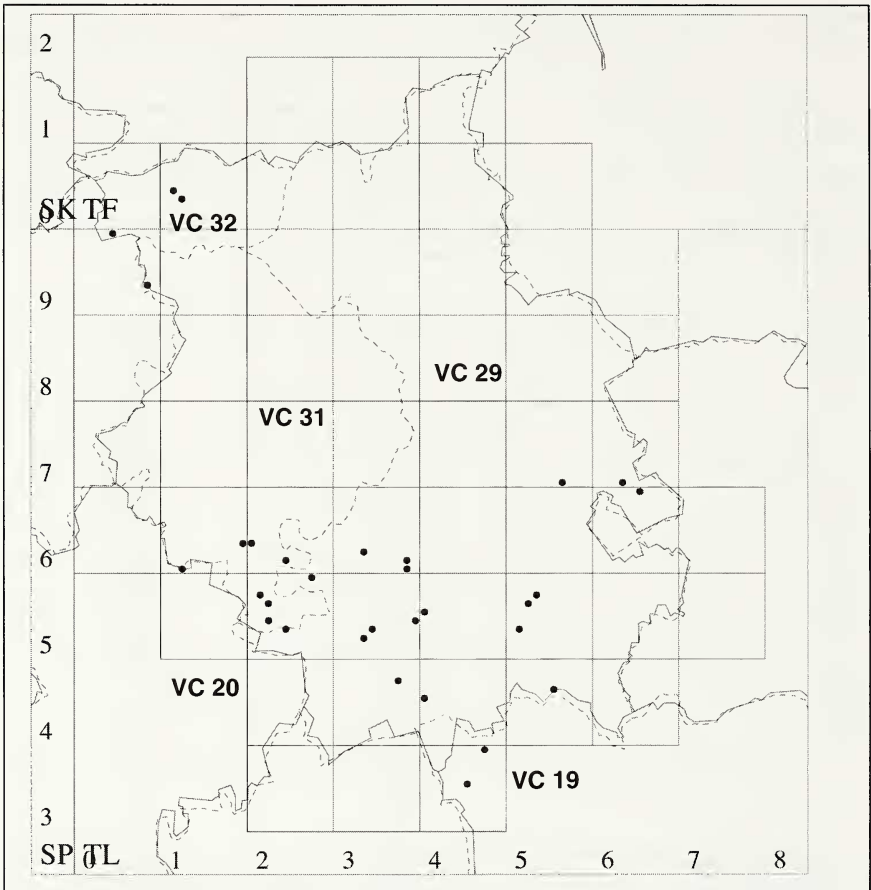


Figure 1. Distribution during the research period of *Xestia rhomboidea* in Cambridgeshire and Essex.

Discussion

During the three years of research much progress in understanding the distribution and ecology of this species has been made. The larvae have been identified in the wild at fourteen sites in Cambridgeshire and Essex, two sites in Scotland and independently at one site in Norfolk (Haggett, 2002). Research has found it feeding on mainly *U. dioica*, *M. perennis* and *P. elatior*. The NBAP suggests *S. media*, *Rumex* spp., and *P. lanceolata* as possible larval food plants but no larvae have been observed on any of these plants even though they were present at many of the sites. Also suggested were more woody species such as *Betula* spp., *S. caprea*, *R. fruticosus* agg. and these may well be used along with *Ulmus* spp. and other trees species for egg-laying habitats and food for early larval stages. However from at least January larvae feed on the range of ground vegetation identified in this study.

While Haggett (2002) found 'one feeding at the tip of freshly sprouted Yorkshire fog *Holcus lanatus*' (1 Feb.) and feeding on *U. dioica* (17 March), no larvae have been observed feeding or even climbing on any grass during this research. Larvae have been observed climbing up the dead stems of the previous years *U. dioica* to feed on new growth of *U. dioica*. Larvae were observed feeding from early January until the 12 April in various locations both on ride and woodland edges and within open woodland.

The adult was found in Cambridgeshire to be numerous at several sites where it had not been recently recorded. There were several records of nectaring on *A. minus* and even though various accounts claim to have observed it in the past, all the *A. minus* plants seemed to have gone over by early August and *D. fullonum* was the most common plant on which the adults were seen nectaring. It could be that early nectaring is on *A. minus*, while later they move on to *D. fullonum*.

Haggett (2002) recorded adults in Thetford forest on the 7 (seven) and 8 (11) of July 2001. This is very early and may be due to the light, well-drained soil conditions in that area. Most records in our study and the national database indicate a late July start for the flight period in England. The peak period seems to be between the 6 and 21 August, with adults recorded up to the end of the month.

The Biodiversity Action Plan suggests that the cessation of coppicing and neglect of woodland management may be factors in the decline of this moth. It is classed as Nationally Scarce (recorded from less than one hundred 10km squares in Great Britain between 1980 and 1999). The species appears to have been lost from the west of England including Hampshire, last seen in 1968 (Goater, 2001) and Dorset, and there are no recent records from Devon and Cornwall, where there is now doubt about some of the old records (McCormick, 2001 and Smith, 1997; see also Parsons, 2004). In Cambridgeshire, it is not exclusively found in ancient woodland. In fact several of the sites are modern plantations, some obviously planted on sites which have not been woodland for many years. These sites are often small or are narrow shelterbelts with an open woodland canopy. Where the moth was recorded in ancient woodland, such as Overhall Grove, the surrounding secondary woodland and plantations were also found to hold populations. The moth thus must have powers of dispersal up to at least one kilometre as this record and records from Fulbourn, and Dry Drayton also suggest.

Three sites where the moth has been recorded had species rich hedgerows nearby. The hedge bottoms had suitable larval food plants but no larvae were found even though at RSPB Grange Farm other small plantations in the area were found to hold the larvae. It is likely that the hedgerows are too open a habitat for the moths.

In Scotland the larvae was found in slightly more open areas of woodland on south or west facing steep slopes. As many small areas of broadleaved woodland match this description and with a wide range of larval food plants used, many of which are to be found in these areas, there could be large amounts of suitable habitat available. Due to the remoteness of many of these sites, and the lack of recorders in many of these areas, only a large scale research project can assess whether the moth is more widespread than is presently thought. An adult was light trapped in August 2004 at Taynish NNR (Field, 2005c) but a further survey at Taynish in March 2005

failed to find larvae for the second year running. However, on the 6 August 2005 two adults were observed nectaring on *A. minus* and *S. jacobaea* and one light trapped.

In central and north Wales there has not been a verified record of the moth for at least nine years with the previous record being nine years older than that (Parsons, 2004), so there must be some doubt as to whether this region still holds populations of the moth.

Conclusions

The moth has two strongholds in Cambridgeshire. One is in the south between Cambridge and St Neots, and this spreads over the borders into the surrounding counties of Essex, Hertfordshire and Suffolk. Most woods in this area have been found to have populations of the moth and many which have not been searched for larvae or light trapped for adults could also hold such populations. There are few woodlands between Cambridge and Huntingdon and no more records except from the north western corner of Cambridgeshire and north Northamptonshire. Here to the west of Peterborough are another set of woodlands with recent records of both adults and larvae. It is quite possible that many of the other woodlands in the area and in neighbouring areas of Northamptonshire and Lincolnshire may also hold populations.

No suggestion can be put forward as to whether the populations are in decline in these areas as prior to the commencement of this study only two or three recent and fairly casual records were available. There was no routine monitoring of these sites and without the present research little current information would be available. However several of these sites could be under threat from future housing and road developments as the Government sees Cambridgeshire and the M11/A1 corridor as prime development areas.

In a separate study, larvae of the moth were found at two sites (near Kyle and Arduaine) in the west of Scotland in 2004, adults were light trapped in 2004 at two sites (near Kyle and Taynish) and in 2005 at two sites (Taynish and Glen Nant), thus removing fears of its survival in Scotland. There is a vast amount of possible habitat which has never been investigated on the west coast and inland along the Great Glen and near Kingussie. This means that the moth could be far more widespread than previously thought or it could just be found in two or three areas now. In Wales the situation is far more unclear with few verified records over the last 20 years and no larvae found during a recent survey (Field, 2005b).

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